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AN EXPERIMENT AND SOME OBSERVATIONS ON *VESPA CRABRO* L. (HYMEN., VESPIDAE)

By R. G. Sandeman, F.R.E.S.

During the last five years the Hornet has become increasingly common around Crickhowell, Breconshire. At one time it was an uncommon insect, and it was unusual to find a nest; now, however, it nests in some numbers, and seems to be increasing. I found no fewer than 14 nests in hollow beech trees in Llangattock Park near here in September 1937. This was an exceptionally large number but one can always find five or six nests every year.

Not only do they nest in hollow trees, which is the typical situation, but also in overhanging river banks, old buildings, fern ricks, and even in the ground, this last situation being most unusual. Contrary to popular opinion, the Hornets are by no means ferocious insects, and one can watch them at close quarters with perfect safety if one is quiet and confident.

To take their nests together with the swarm is, however, a task not to be lightly undertaken. I had long wished to get a life-history of the nesting habits of this species, and last year (11th June, 1939) I had the good fortune to find an embryo nest containing only the queen, situated in the ground.

A friend and I conceived the idea of digging out the comb and transferring it to a box together with the queen, where we could observe the whole social economy of the nest from start to finish. We first timed the departure of the queen and found that she left the nest sufficiently long for us to get out the comb and hang it in a box with a wire passed through it before she came back.

We therefore set to work immediately she left the nest and in about ten minutes we had succeeded in transferring the little comb to the box, and placing the box in the hole where she could see it.

The comb was a typical embryo nest, containing a little group of some twenty cells with larvae and eggs, placed in a little bell-shaped cup of coarse yellow paper composed of the typical rotten wood pulp. It was about 9 inches in circumference.

We had just finished when the queen came back. We never for a moment thought she would take to her new situation, and she flew round and round, hovering low over the grass, and then, widening her circles, seemed quite at a loss as to the position of her nest. Time after time she hovered almost at the entrance to the box, but kept passing it and continued to search along the ground to right and left. She then visited and entered various mouse-holes nearby, evidently mistaking them for the entrance to her nest, then after a few moments emerged and continued her search. This went on for about twenty minutes, and she now appeared hopelessly lost.

At this point we decided on a desperate experiment! Waiting until she entered one of the mouse-holes, we moved the box and placed it over the hole. After several attempts we were able to slide a sheet of glass under it, and finally got her into the box as she emerged from the hole. In lifting the box, however, she escaped and flew straight off. We certainly never expected to see her again after this!

However, to our astonishment and delight, she returned in about five minutes! Again she went down the mouse-hole and once more we got the box over the hole and slid the glass beneath it. This time we succeeded in capturing

her, but her frantic efforts to get out, flying about in the box and up and down the glass, boded ill for her settling down.

Suddenly, however, she alighted on the comb and sat quietly there on the cells with her abdomen and antennae all trembling. We then very quietly placed the box in the excavation where we had dug out the nest, and after packing the soil around it removed the glass. During this operation she remained on the comb, and was still there, apparently quite at home, when we left at 5 p.m.

Returning at 5.30 p.m. we found her still seated on the comb.

The following observations are copied from my notebook :—

5.56 p.m. . . . Queen left nest. Flew round in ever-widening circles and then straight away over house.

6 p.m. . . . Returned and found her new situation beautifully, making only a few circling movements before she entered box and alighted on comb. She carried a large pellet of building material in her mouth. I was able to watch closely from only two feet distant what took place. She went to each cell containing larvae, and poked her head into each one. This, I am convinced, was to moisten the pellet further with the juices from the mouths of the larvae. It could not have been to feed them, because the pellet she carried was of building material and not food. She then applied the pellet to the broken case of the comb, and quickly filled in a small hole. After this, she settled down quietly on the comb and was still there when I left at 6.25 p.m.

My next visit was at 7 p.m. She had evidently been out again, as a wet strip of new paper had been added to the edge of the comb case.

10.15 p.m. . . . Queen settled down for night in comb.

12th June.

9 a.m. . . . Queen now thoroughly at home sitting on comb and had added more material to case.

12 noon. . . . Entered nest with practically no hesitation. Came in up wind. Went inside, then came out and applied large pellet to edge of case, which had been considerably worked upon since the morning. She built quickly, with vigorous movements of her mandibles, only taking one minute to finish the strip. Went inside comb.

12.53. . . . Queen left nest and flew over Park in direction of clump of trees.

I returned at 1.45 p.m. She was inside comb.

1.51 p.m. . . . Queen left nest, flying over Park. The case had now been extended downwards till the cells were hidden, and one could not see what took place inside.

1.59 p.m. . . . Entered nest but did not build.

2.11 p.m. . . . Left nest, circled round twice, then flew up over house. This time while she was away we placed a small mirror in the bottom of the box so that the inside of the comb was reflected in it, and we were thus able to see all that went on and which would otherwise have been hidden by the case.

2.23 p.m. . . . Queen returned with a pellet and built in two places very quickly on case.

2.29 p.m. . . . Left nest flying in usual direction over Park.

2.38 p.m. . . . Came in. The cells, larvae, and all details were beautifully reflected in the glass. She carried a large pellet and went to the cells and put her head in, apparently moistening the pellet with the juices from the mouths

of the larvae. She then built on comb case and then on a cell wall to heighten it. Afterwards cleaned her antennae by drawing them through her mandibles and front legs. Attended larvae. Went up behind comb and rested. Still resting when I left at 3 p.m.

I returned at 7 p.m. to find the queen sitting quietly on the cells containing larvae. Since last observation she had added about half an inch of paper to case of comb, and was now resting quietly on cells with wings along sides of body. Presently she commenced to go from cell to cell attending to the larger larvae. She put her head into each cell and with gentle, flickering, trembling, movements of her antennae seemed to be caressing the grubs. Only the larger larvae were treated in this manner.

At 7.20 p.m. she left the nest and flew over Park.

7.28 p.m. . . . Came in with large pellet, moistened it at mouth of larvae. The juices could be seen coming from their jaws. She then built at edge of comb case. Went back when pellet was half used up and again moistened it in same way, then built again. Went and attended to larvae and also went up behind comb and built at edge of a cell for some minutes.

7.39 p.m. . . . Left nest and flew over Park.

7.48 p.m. . . . Came in carrying piece of rotten wood about half an inch long held between her jaws like a dog carries a bone. Sat on comb and rapidly chewed this up into a large pellet, which she applied to comb case and then to a cell wall. Preened herself and again built at cell wall. Still in nest when I left at 8 p.m. A visit to nest at 10 p.m. revealed the fact that one of the larger larvae had spun up. The queen was tending the others.

13th June.

Commenced observations at 12.29. Queen absent. The case of the comb had by now been brought down about an inch, but there was still a wide opening at the bottom which allowed the comb inside to be well seen reflected in the glass at the bottom of the box. The comb case was composed of one single continuous sheet of coarse paper typical of the Hornet. Rotten wood pulp was the chief material, with a few sand-grains cementing it.

12.42. . . . Queen came in, flying round several times before settling. She went to the cells and sitting there proceeded to chew a large pellet, then built a small strip to case of comb. Went back and up to top of nest behind comb, where she applied remainder of pellet to strengthen the little stalk of material holding comb to the top of case. Came out again on to comb and cleaned her antennae, drawing them through her mandibles, and drawing her front legs over her head in the exact manner of a cat washing herself! This is a typical habit of wasps. I also observed that another of the larvae had commenced to spin its cocoon. It worked with a circular motion of its head as it spun. As it worked the delicate silk covering to the top of the cell grew before my eyes. The queen meanwhile tended the larvae, but did not visit the one spinning up.

1.4 p.m. . . . Queen left nest and flew in usual direction over the Park. I then ceased observation.

4.3 p.m. . . . Queen came in with a large piece of rotten wood, sat on comb and reduced it to a pellet, then built a strip to case, taking about two minutes. Tended young larvae, poking her head into each cell and caressing them with quick flickering movements of her antennae.

4.12 p.m. . . . Left nest and flew over Park.

4.21 p.m. . . . Came in after flying round a little, applied large pellet to

comb case, tended young; she now spent more time tending larvae and did not build so much.

4.37 p.m. . . . Left nest; this time she flew up into a flowering acacia tree about fifty yards away. Amongst these flowers were many Diptera and other insects.

4.38 p.m. . . . Came in with a large object in her mouth, sat on comb and reduced this to pulp. This object was some insect caught in the acacia tree. She went from cell to cell and carefully fed each larva, placing a small portion in each of their mouths. On each of the larvae could be seen a small dark spot of this food, which quickly disappeared as they eagerly fed upon it.

4.44 p.m. . . . Left nest and flew over pond.

4.51 p.m. . . . Came in after flying round six times, carrying large pellet; built on case of comb, then added to the support-strip of material to which the comb was suspended. Then attended to larvae, appeared to be feeding them with liquid from her mouth. I saw her go to one larva and gently stroke and pat it with her front tarsus, with a delicate kneading sort of motion, the larva moving its head about in a circular movement.

5.9 p.m. . . . Left nest and flew up into acacia tree.

5.15 p.m. . . . Came in with a large pellet and fed it to larvae, evidently an insect caught in the acacia tree, which seemed to be its chief hunting ground.

5.25 p.m. . . . Left nest.

5.27 p.m. . . . Came in with small pellet and built behind comb, and tended young.

5.39 p.m. . . . Left nest and flew up into acacia tree. I went over to it, but could not see her. She was back at the nest at 5.50 and feeding young.

14th June.

12.30 noon. . . . Case of comb had now been brought down to complete first layer of embryo nest. From a former experience I know that from this point the queen does not add any more to the nest, building operations being taken over by the workers as they hatch out. The only work the queen does from now on is to lay eggs, and feed the young grubs till the first workers arrive.

The opening at the bottom of the nest was now 2½ inches wide; three of the largest larvae were spun up in a group in the centre of the little slab of comb.

It now appeared certain that the experiment would be a complete success, and that I should obtain a full life-history of the nest. Alas! It proved otherwise. The queen was not present when I visited the nest at 12.30. I waited an hour but she did not appear, nor did I ever see her again. She may have been killed by a bird, or maybe some human just "killed another of those hornets!"

I think the outstanding fact proved by this experiment is the really remarkable attachment of the queen Hornet to her nest. When the workers are present, of course, it is an easy matter, apart from the somewhat dangerous nature of the work, to transplant a nest to a new situation, but I have never heard of any Entomologist who has done this [1] with an embryo nest containing *only the queen*. This is the second time I have done this and in each case only an unfortunate accident has prevented my obtaining a life-history of the nest from start to finish. Here is an opportunity which will fully repay any of our Fellows who cares to take it up.

[1] [*Cf.* Janet, 1895, *Mém. Soc. zool. France* **8**.—Editor.]

VESPIDAE FROM MAFIA ISLAND, EAST AFRICA (HYM.)

By Desmond Vesey FitzGerald, F.R.E.S.

The following notes are based on a small collection of Social wasps collected on the Mafia island group during 1936. The Mafia group constitutes the southernmost of the islands lying close to the coast of Tanganyika Territory, the other two being Zanzibar and Pember. The largest island, Mafia proper, is situated across lat. 7° 50′ south and long. 39° 80′ east and is only about 13 miles from the mainland at the nearest point. While it is probable that other species of wasps occur in Mafia, the present collection is representative of the commoner forms. It is not surprising, in view of the proximity of the mainland, that the species represented on the island are also common throughout the coastal districts of Tanganyika. Records of specimens collected in East Africa are included in the present paper in order to emphasise this point.

I am greatly indebted to Dr. J. Bequaert for identifying the material collected.

Polistes marginalis var. *africanus* P. de B.

This species is one of the most abundant throughout the islands, especially on the little, closely cultivated, island of Tchole, where it is by far the commonest wasp. The wasp is predacious on Lepidopterous larvae, and the mixed growth of annual herbs and vines following cultivation, provide a rich feeding-place for such larvae. This wasp is a foliage-nester, the naked comb being usually found suspended from, and sheltered by, a broad leaf. The lower surface of the pinna of a coconut leaf is a very usual site. A rather curious site in which several combs of this species were collected was under the roof of the porch of disused nests of the weaver bird, *Ploceus nigriceps* Rüpp. This connection between the bird and wasp seems to have been entirely by chance, but it is worth placing on record in view of the more intimate relations which exist between such partners elsewhere.

The comb is roundish or elongate and is supported by an eccentric, highly varnished pillar 2–3 mm. in length. The initial cell is constructed at the end of this pillar and subsequent cells are placed at the side of the older ones. At first the cells are pocket-like, several are constructed at the same time and an egg is laid in each at once. Later the cells are enlarged. The cells widen out slightly from the base towards the mouth. The length of a full-sized cell is 16 mm. and the diameter at the mouth is 2·5 mm. The material employed is a pliable, rather loosely woven, grey "paper." The pupal caps are white and semi-transparent, slightly convex and fill the mouth of the cell.

One small nest composed of five pocket-like cells was attended at the time of collection by a single female. The largest nest collected comprised thirty-nine cells. Drops of honey stored in a few cells were noticed in two nests. The larva is parasitised by a Tachinid, *Anacamptomyia africana* Bischof. The fly maggot emerges from the full-grown wasp grub and then pupates within the cell of its host. The puparia completely fills the cell, and viewed from the open end appears as a convex brown cap within the month. The parasitised nest was taken on the mainland near Dar-es-Salaam.

Specimens of this wasp were collected in the following localities: MAFIA Is.: Kilindoni, 3.vii.36, 7.vii.36; MAFIA GROUP: Tchole Is., 8.vii.36; and in TANGANYIKA: Dar-es-Salaam, 4.vi.36; Bagamoyo, 15.vi.36; Morogoro, 3.v.36; and Uluguru mountains, at 3000 ft., 31.v.36.

Polistes madecassus var. *fastidiosus* de Sauss.

A single colony of this species was found under the eaves of the lighthouse buildings at MAFIA Is.: Ras Mkubi, 12.vii.36. The fact that such a large and conspicuous wasp was encountered only on this single occasion on the island indicates that this species is a casual immigrant to the island.

Polistes smithii de Sauss. typical form.

MAFIA Is.: Kilindoni, 3.vii.36 and 7.vii.36; MAFIA Is.: Utende, 8.vii.36.

Ropalidia tomentosa (Gerst.).

This species is also a foliage-nester. The single comb examined was elongate, two cells wide and supported by a rather stout, 4-mm. long, slightly varnished pillar from about the middle of its length. The initial cell was subtended by the pillar and the next cell was constructed at the side of the first, the third cell in the angle between the first and second. Subsequent cells were similarly placed in the angle between the previous two so that they were arranged in alternate series first right then left, the twenty-two cells forming a comb 42 mm. long and about 5 mm. wide. The individual cells varied very much in depth since some were new, pocket-like and contained an egg. Others were enlarged to fit the size of the larva which they contained. Those containing pupae were full sized, 13 mm. deep and 3 mm. in diameter. The old vacated cells were in various stages of being cut away. The cells are sharply hexagonal. The material employed for cell construction is a rather hard, rather closely woven " paper " which is laid down in circular bands of various colours so that the cells appeared to be zoned pink, yellow, grey and brown. The pupal caps are semi-transparent lightly peppered with fragments of " paper " and convex in shape, filling the mouth of the cell. When first constructed the bottom of the cell is entire, but when the larva is approaching full size, or possibly earlier, the bottom of the cell is perforated with a large irregularly circular hole which is " glazed " over with a semi-transparent membrane. The presence or absence of this " window " in the bottom of the cell at once indicates if any particular, pocket-like, cell is a newly formed one or an old one cut down. This species is parasitised by a dipteron which pupates within the cell of its host and is probably the same as that recorded from *Polistes marginalis*.

Specimens from: MAFIA Is.: Kilindoni, 5.vii.36; MAFIA GROUP: Tchole Is., 26.vii.36; and in TANGANYIKA: Dar-es-Salaam, 8.vi.36 and Dondo, near Dar-es-Salaam, 28.vi.36.

Ropalidia nobilis (Gerst.).

The comb of this species, which was examined, was situated under the eave of a house. The comb of twenty-four cells was more or less circular and it was supported by a pillar subtending the initial cell, which was located near the margin of the comb. The size of the cells varied, some being pocket-like; those containing pupae were 15 mm. deep and 4 mm. in diameter and old cells were in various stages of being cut down. The cells of the present species also resemble those of the last in the texture of the paper, the zonation of colouring, pinkish,

however, predominating, and in their sharply hexagonal sides. The pupal caps are rather flat and they are situated just within the mouth of the cell. These caps are opaque and ornamented on the outside with fragments of " paper " which appear in some cases to be derived from the partially cut-down rim of the mouth which extends beyond the pupal cap. " Windows " occur in the bottom of full-sized cells.

Specimens were collected at : MAFIA : Kilindoni, 3.vii.36; and in TANGANYIKA : Dar-es-Salaam, 8.vi.36; and Morogoro, 29.v.36.

Ropalidia cincta (Lep.).

A comb of this species was situated under the eaves of a house and another was located under the pinna of a coconut leaf. The first comb comprised twenty-four cells; it was leaf-shaped; the stout, flattened, 4-mm. long stalk being located on the margin at the point where the comb was narrowest. As in the case of the two previous species, the cells were variable in depth, the vacated ones being cut down. The texture of the paper, the zonation of colours, the predominance of pink and the sharp angles between the walls of the cells were also noticeable characters of the cells of this species. Pupal caps were not available for examination, but the windows in the bottoms of the full-sized cells were present.

Specimens from : MAFIA Is. : Kilindoni, 7.vii.36; MAFIA Is.: Chaki-Chaki, 21.vii.36; and in TANGANYIKA : Dar-es-Salaam, 8.vi.36; Bagamoyo, 15.vi.36; Morogoro, 29.v.36.

Belonogaster griseus (Fab.).

This was the only species of the genus collected in the archipelago. Specimens were taken at : MAFIA Is. : Kilindoni, 5.vii.36; and MAFIA GROUP : Tchole Is., 8.vii.36.

The following solitary VESPIDAE were also collected on the islands : *Eumenes melanosoma* var. *longirostris* Gerst. MAFIA Is.: Mrali, 10.viii.36. A " pot " of this species examined at TANGANYIKA TERRITORY : Morogoro, was composed of very " glazed " chocolate-coloured mud. An unusual feature of this specimen was that the flanged neck, which is always constructed by wasps of this genus and is used as an opening during the storing of the cell, was sealed up and left intact on the full cell. In the case of other species this neck is usually removed from the fully stored and sealed cell. The young wasp emerged through a hole bitten in the side of the " pot."

Other species collected were : *Eumenes maxillosus* (Deg.) typical form, MAFIA Is. : Kilindoni, 17.vii.36; *Synagris analis* de Sauss., MAFIA Is. : Kilindoni, 7.viii.36; *Odynerus* (*Ryghium*) *lateralis* var. *unicolor* v. Schulth, MAFIA Is. : Mrali, 10.viii.36; *Rhynchalastor fuscipennis* Meade-Waldo (=*Odynerus ferrugineus* var. *mafiensis* v. Schulth), MAFIA Is. : Hongoro, 11.vii.36; *Labus natalensis* de Sauss., MAFIA Is. : Hongoro, 11.vii.36.

BRITISH LEPIDOPTEROUS COCOONS WITH VENTILATION (?) HOLES

By C. N. Hawkins, F.R.E.S.

1. Two cocoons of *Eriogaster lanestris* (L.) were exhibited; one cut open to show the internal aspect opposite the external holes. The holes in the cocoon of this species are referred to by Borkhausen, Tutt (quoting Hewett), and probably others, and are presumably made by the jaws of the larva after the external hard shell has been completed but before it has quite solidified. In most cases, but not always, the holes are in pairs corresponding to the two larval jaws, which are not allowed to meet completely enough to finish the bite. Occasionally, however, the holes are joined into a single larger one, and in that case the assumption is that the larval jaws take a full bite. Subsequently the larva evidently spins an inner lining to the cocoon, consisting of uncemented silk, and in this there are no corresponding holes, but where these holes occur in the outer shell, and for some distance round, the silken lining is not attached, so that a space is left here between the inner and outer walls of the cocoon. Usually there are two pairs of holes in each cocoon, a pair on each side (or thereabouts).

2. A cocoon, spun in captivity, of *Hipparchus papilionaria* (L.) formed of birch leaves tightly spun together by the larva. This cocoon also has a number of holes in the birch leaves, which the larva was seen to produce by biting from the inside after the cocoon had been formed. Here again the holes are frequently in pairs, corresponding to the two jaws of the larva, which normally did not quite meet. This particular cocoon is, perhaps, unusually well covered by the birch leaves, for the species, but I have noted the same habit in other examples, though I am not aware that it has been recorded. In the case of *E. lanestris*, it has, I believe, always been assumed that the holes are for ventilation, and presumably those in *H. papilionaria* are for a similar purpose, but it may be that in both cases they also allow a certain amount of moisture from rain &c. to reach the enclosed pupa to prevent drying up.

NOTES ON BEMBICIDAE AND ALLIED WASPS FROM TRINIDAD (HYM.: BEMBICIDAE AND STIZIDAE)

By Desmond Vesey FitzGerald, F.R.E.S.

Rubrica surinamensis (Degeer).

This species is the commonest and most conspicuous wasp belonging to the family Bembicidae in Trinidad. *Rubrica* is a gregarious nester, the colonies being situated in areas of bare sandy ground exposed to the hot sun. Paths, from the surface of which all the vegetation has been worn, being very favourite sites. The female wasp burrows into the ground in a way which may be best described as resembling the method employed by a dog. The soil is scraped away with the front legs, any particularly resistant bits being torn loose with the mandibles, while the loosened particles are cast aside with the hind legs to form a fan of excavated material around the entrance of the hole. In this respect the work of *Rubrica* is essentially different from the work of *Sphex ichneumoneus* L., a wasp which often nests with the former. *Sphex* gathers up the loosened soil and, clasping the particles against the underside of the thorax, carries them a few inches away from the entrance to its hole before dumping them. Thus, by contrast, there is a clearly marked zone free from any debris between the entrance hole and the pile of excavated soil.

Rubrica always chooses the hottest part of the day, the early afternoon, during which to do the hardest work. While the females are occupied digging, the males fly round the area in circles or they may be seen at rest on objects in the vicinity. At night the males and females segregate and rest on vegetation, the former in groups of many individuals together. Newly completed burrows and those already containing a very young larva are always carefully closed whenever the female wasp goes away. When the grub is older, however, the parent wasp does not trouble to close the entrance. The method employed by the wasp to close the entrance is as follows. First the female wasp appears head first in the entrance of the burrow and starts scraping loose particles towards herself. As the entrance fills up she comes farther and farther out, all the time alternating the action of scraping up soil with periods of vigorous tamping with the tip of the abdomen. When the entrance is closed she suddenly flies away without inspecting her work.

The larvae of *Rubrica* are fed on adult flies of large or medium size. A variety of species are caught, depending, no doubt, upon availability. The most usual kinds brought in, however, by individuals kept under observation were the Syrphid, *Volucella obesa* Fabr. and Tabanidae including *Tabanus occidentalis* L. The adult goes on feeding the larva as the latter grows. The larva lies in the chamber at the end of the burrow curved into a shape resembling a capital "J," the head being bent round on to the underside of the thoracic segments. In the angle thus formed the fly, which is supplied to the larva in a paralysed condition, is clasped while it is being consumed. A full-grown *Rubrica* larva was observed to finish up a whole individual of *Volucella* in a single afternoon, every part being eaten except for fragments of the legs, wings and hard exoskeleton. The larva pupates within a silken cocoon.

In view of the fact that *Rubrica* is such an energetic hunter of Diptera, it is

of interest to note that the fly *Pachygraphomyia spinosa* Malloch is a constant attendant of the wasp. These flies hang around the vicinity of the nesting holes and they are presumably parasitic, although this has not been proved by observation. The fly has, however, been seen to enter the freshly opened burrow of the wasp, but in the case observed its exit was precipitated because the parent wasp chased it out. It was noted above that the wasp is careful to close the burrow containing a young grub whenever she goes away but is negligent about this precaution when the larva is nearly full grown. It may be significant, therefore, to note that *Pachygraphomyia* will enter burrows opened up by a returning wasp but takes no notice of burrows containing a full-grown larva which are left open while the wasp is away.

Pachygraphomyia is an extremely alert fly and thus may be able to take care of itself even though living so close to a potential predator. However, *Rubrica* has never been seen to take any interest in this fly except when it actually enters a burrow and it seems that the explanation suggested by Dr. O. W. Richards, who determined the species, is the correct one. He suggested that the hunting reflex of *Rubrica* is not active in the immediate neighbourhood of the nesting site, hence so long as *Pachygraphomyia* keeps sufficiently close to the centre of activity round the nesting holes it is safe.

Liohippelates pusio (Loew) is another Dipteron associated with the *Rubrica* colonies. In the case of this species its small size causes it to be beneath the notice of the wasp. The fly has often been seen entering and leaving the open burrows of the wasp. The exact rôle of this species has not been elucidated but it is presumed that small larvae of a Dipteron which are frequently seen feeding in the debris composed of excreta and fragments of prey, which collects in the brood chamber, are the larvae of this species.

The distribution of *Rubrica* in Trinidad is indicated by the following locality records: Trinidad: Northern Range, Mt. St. Benedict, 8.iii.33; Mt. Tabor, 10.xi.31; East Coast, Balandra Bay, 19.vii.33; St. Bernard, Mayaro, 29.xii.34; Central districts, O'Meara Savannah, 30.iv.32; Hart Trace, Plum Road, 10.i.35; Southern districts, Erin Savannah, 24.i.35.

Bicyrtes discisa (Tasch).

This is another common species in Trinidad which nests in similar situations to those favoured by *Rubrica*. A particularly likely place to find a colony of *Bicyrtes* is in the area of hot dry sand at the top of a beach beyond the reach of the highest tides. The burrows of this species descend into the ground at a steep angle for some 12 cm. The female wasp catches nymphs of Heteroptera including Pentatomidae. The victim is carried into the burrow, and the egg is laid plastered along the proboscis.

The distribution of this species in Trinidad is indicated by the following collecting records: Trinidad: Northern Range, Mt. St. Benedict, 17.xi.34; Mt. Tabor, 24.i.32; St. Michaels Valley, 6.iv.33; Eastern districts, Pt. Radix, 8.iv.33 & 4.iii.35; Nariva, 10.iii.35; South Coast, Guayaguayare, 25.xi.34 & 20.i.35.

Stizus cingulatus Sm.

The present species also nests in similar sites, often sharing an area with *Rubrica* and very frequently colonising the beach edge above high-water mark. The adult wasps have been known to catch Homoptera.

Specimens from: Trinidad: Northern Range, Gasparillo Road, 28.x.34; Maracas Bay, 1.x.33.

Microbembex monodonta (Say).

Microbembex has invariably been found nesting near the seaside, either in sandy flats at the mouths of rivers or in the dry sand above high-water mark. The burrows descend for some 8 inches below the surface, often reaching a zone of slight moisture. By contrast to all the above-noted species, which show a certain conservative tendency in the matter of their prey, the present species is extremely catholic in this respect. A great variety of small winged insects have been found in the burrows, small winged ants and, when available, winged termites being among the most frequently captured prey.

Specimens from: TRINIDAD: North Coast, Maracas Bay, 28.x.34; Salybia Bay, 19.v.35; South Coast, Guayaguayare, 25.xi.34 & 20.i.35; Erin River mouth, 23.i.35.

Acknowledgements.

I am indebted to Prof. J. B. Parker, The Catholic University of America, for determining the wasps mentioned in these notes.

BOOK NOTICE.

The Butterflies of the Niagara Frontier Region. By W. WILD. (*Bull. Buffalo Soc. nat. Sci.* **19**: 1–55, 8 pls.) 1939.

This work deals with the Rhopalocera of the area within a radius of some 50 miles of Buffalo, and the systematic arrangement adopted is that of Dr. McDunnough's 1938 Check List.

The four divisions of the work are the introduction; collecting, rearing and preserving of butterflies and moths; what are butterflies; and the butterflies of the Niagara Frontier Region. A check list of the species is given and there is a Bibliography and an Index.

There is much information of use to a beginner.

THE BLACK FORM OF *CICINDELA CAMPESTRIS* L. var. *FUNEBRIS* STURM. (COLEOPT.)

By Dr. K. G. Blair, F.R.E.S.

The specimen of *C. campestris* var. *funebris* was taken by Mr. E. Taylor on Dunkery Beacon, Somerset, on 22nd Aug. 1939. The only other British record of this form that can be traced is that of the specimen taken by the late Dr. T. A. Chapman in Glen Finnart in Oct. 1858 (1867, *Ent. mon. Mag.* **3** : 251). On this record is probably based Fowler's "Clyde district of Scotland (Loch Long, &c.)." In Dr. Sharp's collection is a specimen from the New Forest, June 1910, that matches Mr. Taylor's specimen very closely, both being dull black above with the usual yellow spots rather indistinct, in both the underside shows quite strong purplish colours. These records seem to indicate that the form may occur anywhere with the type and is not a mountain race.

The cause of this black coloration is obscure—it is definitely not due to grease—but is probably some structural defect in the formation of the fine laminae to which the normal metallic colouring is due.

It is known that the insect undergoes some change in colour during life, freshly emerged specimens being of a brighter green than those that have been out some time, a change due apparently to continued exposure to sunlight, and it is possible (though scarcely probable) that the dark green dull-coloured form sometimes found (var. *nigrescens* Heer, 1838) is but a sign of old age. The var. *funebris*, however, can scarcely be a form of extreme senility, or intermediate stages would be more frequent.

A somewhat parallel instance of age variation in colour, with a sudden black aberration, is afforded by *Cetonia aurata* L. and its var. *nigra* Gaut., though the black form in this case is confined in this country to the Scilly Islands.

COLEOPHORA OTITAE ZELLER, NEW TO BRITAIN (LEP.)

By H. M. Edelsten, F.R.E.S.

The larval cases of *C. otitae* were found in South-east Kent in June 1939. The larvae make white blisters on the leaves of *Silene nutans*. The imago appears in August and September. Larval cases of *C. nutantella* are to be found on the seed capsules of *Silene inflata* from August until the spring. The case is very much shorter than that of *C. otitae*. The imago appears in June.

I am indebted to Mr. H. D. Stringer for identifying *C. otitae* and to Mr. L. J. Ford for lending specimens of *C. nutantella* for exhibition.

A GYNANDROMORPH SPECIMEN OF *ANACRIDIUM MOESTUM* (SERV.) ORTHOPTERA, ACRIDIDAE

By Edith Potter, Ph.D., D.I.C., F.R.E.S.

(*Rothamsted Experimental Station.*)

Introduction.

A gynandromorph of *Anacridium moestum* (Serv.), discovered by Dr. M. A. Volkonsky, Institut Pasteur of Algiers, amongst material bred in cages, was sent to me by Dr. B. P. Uvarov of the Imperial Institute of Entomology, for study.[1]

The gynandromorph had been killed and fixed in Bouin's fluid; this was necessary, but made the finer dissection of the internal organs difficult as they were rendered very brittle.

This paper is a description of the external characters of the gynandromorph, the internal anatomy of the genital organs and a comparison with the normal male and female of the same species.

The terms used in this description are those employed by Dr. R. E. Snodgrass in his papers on grasshoppers and in his textbook *The Principles of Insect Morphology*.

I have to thank Dr. Volkonsky and Dr. Uvarov for giving me the opportunity of studying this unique insect, and Dr. Tattersfield for allowing me the facilities of his laboratory.

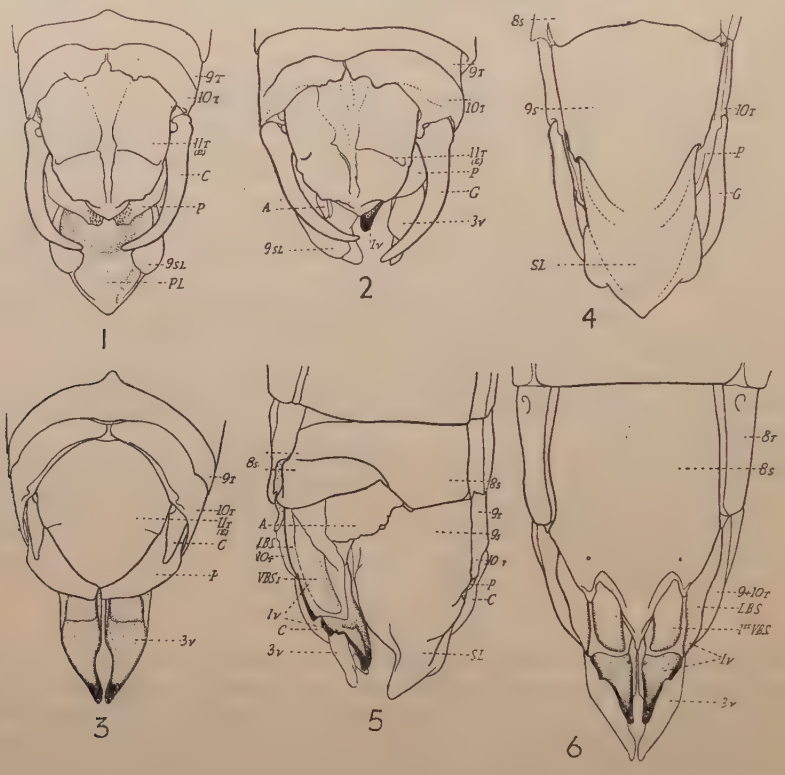
External Characters.

The normal male and female *Anacridium moestum* are similar to each other in general external structure, but the cerci and eleventh tergite show distinct sexual dimorphism. The cerci of the male are long and sickle-shaped, but those of the female are small and peg-like (figs. 1 and 3, C). The eleventh tergite of the male is sculptured, that of the female is smooth (figs. 1 and 3, 11 T). It is in the character of these organs and the genitalia that the interest of the gynandromorph lies.

[1] Gynandromorphism in Acrididae appears to be rare. Hebard (1919, *Trans. Amer. ent. Soc.* **45** : 268, footnote) reported a specimen of *Oedaleonotus phryneicus* Heb. with the left side of a male and the right of a female, but no description even of the external morphology was given. Carothers (1939, *Genetics* **24** : 97) recorded a complete gynandromorph produced as a hybrid between *Trimerotropis citrina* Scudd. ♂ × *T. maritima* Harr. ♀, which had the left side externally of a male, but no sign of internal reproductive organs of that sex; the right side was that of a female externally and had a normally developed ovary. Natori (1931, *Trans. Sapporo nat. Hist. Soc.* **12** : 1–5) gave a detailed description of a larva of *Podisma sapporense* Shiraki, with the external genitalia of a male but a testis, of normal size, with a mass of ovarian tissue attached to it; spermatogenesis in the testis was accomplished normally, but in the ovary part of the ovo-testis the eggs were immature. Thus, no gynandromorph that would be complete both externally and internally is yet recorded in Acrididae, and the case described by Mrs. Potter is no exception.—B. P. Uvarov.

The modifications of this gynandromorph first appear dorsally in the eleventh tergite and ventrally in the eighth sternite. Although some irregularities of shape and changes in proportion occur in the eleventh tergite of the gynandromorph (fig. 2, 11 T), the insect is dorsally a slightly misshapen male with no typically female characters. It has the usual male cerci and the sculptured tergite of the normal male.

The eighth sternum of the normal male is narrow (fig. 4), that of the female is wide and is produced into a median lobe or egg guide (fig. 6). The



FIGS. 1–6.—Dorsal view of terminal segments of: 1, male abdomen; 2, gynandromorph; 3, female abdomen; ventral view of terminal segments of: 4, male abdomen; 5, gynandromorph; 6, female abdomen.

eighth sternite of the gynandromorph is male on the right side, but at the mid-line it narrows and is deeply folded laterally. This narrowing and folding is probably due to wounding, as a large lump of indeterminate tissue is attached to its distal margin and overlies the genitalia (fig. 5, 8 S).

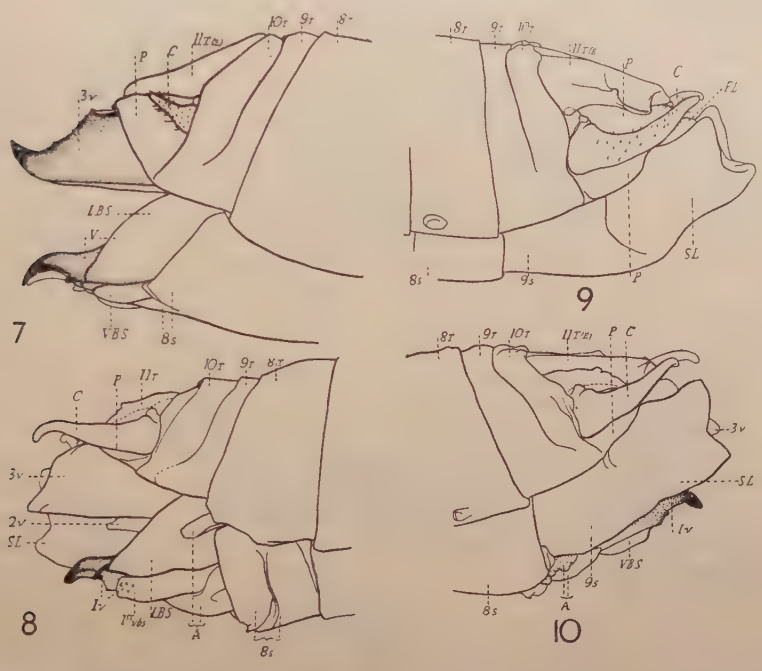
The male ninth sternum is present on the right side (*ventral view*) (fig. 5, 9 S), but is shorter than in the normal male; the subgenital plate (fig. 5, SL) is considerably shortened and only the right side of it is developed.

On the left side and partially overlaid by the amorphous tissue of the eighth sternum lies the first valvula of the female genitalia (fig. 5, 1 V) slightly distorted and curving outward instead of inward (cp. fig. 6, 1 V). The lateral

and first ventral basivalvular sclerites are present (LBS, VBS). The latter are larger and more prominent than in a normal female. The dorsal or third valvula is present, but dorsally its structure bears some resemblance to the dorsal part of the subgenital plate of the male; ventrally it has the straight edge of the normal third valvula, but its apex is not upturned. It is not strongly cuticularised (fig. 8, 3 V). A small lobe, the second valvula, which is membranously connected with the third, is present (figs. 11, 14, 2 V).

The left half of the ninth sternum and subgenital plate of the gynandromorph are not so deep and pouchlike as that of the normal male (cp. figs. 9 and 10).

From the above description it can be seen that this gynandromorph tends



FIGS. 7–10.—Right lateral view of end of: 7, female abdomen; 8, gynandromorph abdomen; left lateral view of end of: 9, male abdomen; 10, gynandromorph abdomen.

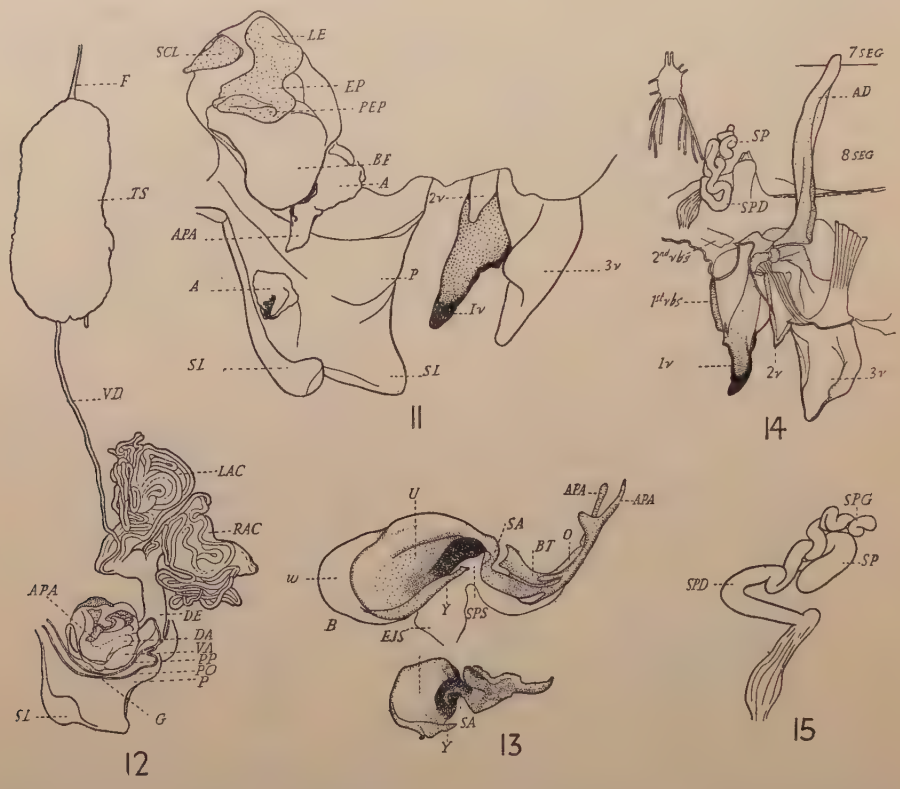
externally to be more male than female. Dorsally it is male, ventrally it is half male and half female.

INTERNAL GENITALIA.

The gynandromorph is male internally as far back as the distal part of segment seven, where the right side takes on female characters, the left side remaining male.

The apparently normal testes lie in the fourth, fifth and part of the sixth segments, dorsal to the gut, as in the normal male (fig. 12, TS). The testes are applied to each other and have a common supporting filament (F). From the left testis a vas deferens (VD) passes posteriorly beside the gut to enter

the ductus ejaculatorius (DE) at the base of the left accessory gland (LAC). The latter consists of a mass of small tubules entering the left branch of the ductus. The accessory gland of the right side is present (RAC), but lies more towards the left side of the animal than is usual. The two short branches of the ductus unite and the common ejaculatory duct passes over to the left side of the insect and enters the subgenital lobe (SL). The ductus of the normal male passes into the ejaculatory sac, which is contained in the endophallus (fig. 13, B). Only a trace of the right vas deferens was seen.



Figs. 11–15.—11, Male and female genitalia of gynandromorph; 12, male genitalia of gynandromorph; 13, endophallus of (A) male genitalia of gynandromorph and (B) normal male, left side; 14, female genitalia of gynandromorph, spread out; 15, spermatheca of gynandromorph.

When the epiproct (11 T) was removed and the podical plates (P) were slit and spread apart it could be seen that the left sclerite, giving insertion to the retractor muscles, is present (fig. 11, SCL) and also part of the epiphallus, the lateral lobe (fig. 11, LE) and the posterior process (PEP). The bridge of the epiphallus is not present, since only the left half of the subgenital lobe is developed (SL).

Distal to the posterior process of the epiphallus is a membranous fold, which probably represents the left half of the basal fold (BF), lying against

the folded pallium (P). Below the basal fold protrudes a triangular cuticularised process, probably an apical process of the aedeagus (APA).

The much-modified male genitalia were exposed by removing the pallium and slitting the basal fold. The genitalia are so much reduced and distorted that the homologies given here can only be tentative. The ejaculatory duct (fig. 12, DE) enters the subgenital lobe at its extreme inner margin and appears to open directly into the genital cavity (G). Arising from the floor of the genital cavity is a globular structure which seems to consist ventrally of the left part of the ventral lobe (VA) and dorsally of the dorsal lobe of the aedeagus (DA). Projecting from the apex of the dorsal lobe is a sclerite which appears to represent one of the ventral apical processes of the aedeagus (APA). Dorsally the dorsal lobe is incomplete and the homologies of the dorsal cuticularised structure could not be determined. Neither the dorsal nor the ventral lobe is complete, and no phallotreme cleft could be seen on the dorsal lobe, only half of which is presumably present.

The endophallus or "sperm ejection pump" (Snodgrass 1935a) consists only of the left side with its muscles and is much reduced in size and distorted. Fig. 13 shows the endophallus of the gynandromorph A compared with the left view of that of a normal insect B, dissected out and freed from muscle. As the gynandromorph endophallus is incomplete and the ductus opens directly into the genital cavity, it would seem that the male part of the genital organs are unlikely to be functional. Even though the sperms were normal, there is no mechanism for inserting them into the female.

No trace of ovaries or common oviduct could be found. The right apodeme of the genitalia, arising between the bases of the third and first valvulae, is present and extends into the distal part of the seventh segment (fig. 14, AD) as in a normal female. The cavity or pouch found in the female between the eighth sternite and the external genitalia is absent.

Slightly to one side of the mid line, in the eighth segment, lies a spermatheca and its gland (SP and SPG), similar in external structure to that of a normal female. The spermathecal duct appears to open into the side of a short blind tube, which terminates above the indeterminate or wound tissue at the base of the first valvula (1 V) and the posterior margin of the eighth sternite.

The second ventral basivalvular sclerite of the first valvula is vestigial (second VBS). In the normal insect it forms half the bow protecting the opening of the spermathecal duct. In the gynandromorph only its outer apex is present.

Conclusions.

The gynandromorph of *Anacridium moestum* is not complete, but is more male than female. Externally, it is male dorsally; but is half male, half female on the ventral side.

Internally, the insect is also more male than female. It possesses part of all the male organs, but only the spermatheca of the female.

It is not possible, without cytological examination, to know whether normal sperms were produced. Even though they were produced there is no mechanism for conveying them to the female and it is probable that the insect was functionally sterile, although it may have produced fertile sperms.

The cause of the production of the amorphous tissue is unknown.

References.

Snodgrass, R. E., 1935, The abdominal mechanisms of a grasshopper. *Smithson. misc. Coll.*, **94** (6).
——, 1935a, *Principles of Insect Morphology.*

Abbreviations.

A	Amorphous tissue.
AD	Apodeme.
APA	Apical process of aedeagus.
BF	Basal fold.
BT	Bridge of anterior phallotreme sclerites.
C	Cercus.
DA	Dorsal lobe of aedeagus.
DE	Ductus ejaculatorius.
E	Epiproct.
EJS	Ejaculatory sac.
EP	Epiphallus.
F	Supporting filament.
G	Genital chamber.
LAC	Left accessory gland.
LBS	Lateral basivalvular sclerite.
LEP	Lateral lobe of epiphallus.
O	Anterior (dorsal) lateral sclerite of phallotreme cleft.
P	Paraproct (podical plate).
PEP	Posterior process of epiphallus.
PL	Pallium.
PO	Cut edge of outer wall of pallium.
PP	Cut edge of inner wall of pallium.
RAC	Right accessory gland.
S	Sternite.
SA	Arm of posterior phallotreme sclerite.
SCR	Sclerite giving insertion to retractor muscles.
SEG	Segment.
SL	Subgenital lobe of ninth sternum.
SP	Spermatheca.
SPD	Spermathecal duct.
SPG	Spermathecal gland.
SPS	Spermatophore sac.
T	Tergite.
TS	Testes.
U	Lateral plate of endophallus.
1 V	First or ventral valvula.
2 V	Second or inner valvula.
3 V	Third or dorsal valvula.
VA	Ventral lobe of aedeagus.
VBS	Ventral basivalvular sclerite.
VD	Vas deferens.
W	Anterior apodeme of endophallic plate.
Y	Gonopore process of endophallic plate.

Book Notice.

Adaptive coloration in Animals. By H. B. Cott with an introduction by J. S. Huxley. 8vo. London (Methuen) (1940). pp. xxxii + 508, 1 pl. col., 48 pls., 84 figs. Price £2.

This book is an attempt at a comprehensive treatment of the nature and meaning of coloration in the animal world. The first part deals with concealment either to escape enemies or to capture prey, the second with advertisement whether for warning or alluring and the third with disguise—with animals that imitate other animals or their own environment. Many of the illustrations are from original photographs made by the author, who is an expert photographer, and all the text illustrations are from originals by the author. There is a bibliography of nearly 700 titles, and indices are provided to scientific names, authors' names and to subjects.

In the Introduction is the following statement: "... by applying optical and psychological principles, he [the author] has pushed the analysis of visual allaesthetic characters to a new level, and shown that many of them constitute adaptations of a quite unsuspected degree of refinement. Far from genetics in any way throwing doubt on their adaptive interpretation, the facts of cryptic, warning and mimetic coloration pose searching questions to the geneticist, and demand a recasting of many current views on the efficacy and mechanism of selection."

Book Notice.

La Faune de la France en tableaux synoptiques illustrés. Tome 7: Hyménoptères. Par L. Berland. 8vo. Paris (Delagrave). 213 pp., 712 figs.

This volume completes the series of illustrated volumes on the Fauna of France commenced in 1923.

It opens with a short introduction, which is immediately succeeded by the main body of the work arranged in keys.

The aim of the work is not to provide the specialist with a means of identifying the species of Hymenoptera of France but rather to assist the non-specialist to obtain some idea as to the identity of his specimens at least so far as the genus to which a given insect belongs.

The very large number of species concerned, possibly 10,000 in France, prevents an attempt at specific keys for all the Hymenoptera of France without producing a very much larger volume.

The many figures consist of outline drawings of the whole insect with details of the parts necessary for identification; they are in the main original, and made from nature. The book is of a size which permits its easy transport in the pocket.

Book Notice.

A Text-book of Zoology. By T. J. Parker and W. A. Haswell. 6th edition in 2 volumes, revised by O. Lowenstein. Vol. 1, pp. xxxii + 770, 733 figs. 8vo. London (Macmillan), 1940. Price 36*s*.

The first volume of the 6th edition of this famous text-book has appeared and it is revised by Dr. Lowenstein of the University of Glasgow. The reviser has aimed at retaining the fundamental character of the book, which attempts an inductive treatment of the subject matter, based on detailed type descriptions to which in every case are added an account of the classification and an extensive comparative account of the general organisation of the members of the group.

The hypothetic phyla of the original work are now abandoned in favour of those generally adopted in modern Zoology.

This volume contains the introductory matter and that part of the general work relating to the invertebrates proceeding from the Protozoa and extending so far as the Echinodermata including the Arthropoda.

The Arthropoda comprise pages 385 to 536.

Book Notice.

Studies in the Mecoptera. Biology and Morphology of some North American Bittacidae. By L. R. Setty. The genital anatomy and mating behavior of *Boreus brumalis* Fitch. By K. W. Cooper. *Amer. Midland Nat.* **23** : 257–367, text illust. 1940.

The first of the two papers here to be noticed is much longer than the second and extends to nearly 100 pages.

It is written as the result of first-hand study of the living insects of several species of *Bittacus*. The study was pursued both in the field and in the laboratory.

The full life-history of several species is described in detail as is the morphology and the internal anatomy.

The second and shorter paper is concerned only with a single species and gives a detailed account of the genitalia of the male and female and describes the mating behaviour and act of copulation. All the dissections for this work were made from living specimens.

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Smith, A., 1936, New species of Coccidae, *Proc. R. ent. Soc. Lond.* (B) **6** : 301–306, pl. 1.

——. 1936, New species of Coccidae, *Trans. R. ent. Soc. Lond.* **84** : 901–936.

Titles of periodicals cited are to be abbreviated in the manner indicated in the *World List of Scientific Periodicals, 2nd edition*, 1934.

Authors are entitled to receive 25 copies of their papers free of charge and may purchase additional copies provided that request be made before publication.

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MEETINGS

TO BE HELD IN THE SOCIETY'S ROOMS

41, Queen's Gate, S.W.7

1940.

Wednesday,	October	2	5.0 p.m.
,,	November	6	5.0 p.m.
,,	December	4	5.0 p.m.

1941.

Wednesday,	January	15	(Annual Meeting)
,,	February	5	5.0 p.m.

THE ROYAL ENTOMOLOGICAL SOCIETY OF LONDON

The Fellowship and Fees

Fellows pay an Admission Fee of £3 3*s*. The Annual Contribution of £2 2*s*. is due on the first day of January in each year, and is payable in advance. Fellows under the age of 25 years may pay the entrance fee in three equal annual instalments.

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Forms of application for Fellowship, copies of the Bye-Laws and the List of Fellows may be obtained from the Registrar.

Meetings and Exhibitions

Fellows and others wishing to make a communication to a General Meeting of the Society are requested to send in their names, the title of their exhibit, and a short abstract of their remarks, to the Registrar fourteen days before the meeting at which it is proposed to make the communication. Should it be desirable to publish a fuller account of the communication the manuscript may be submitted for publication in *Proceedings Series A* or *Series B*. If the epidiascope is required, 24 hours' notice must be given. Objects for projection should not exceed 6 ins. by 6 ins.

Fellows resident abroad, or otherwise unable to attend meetings, are reminded that notes or observations sent to the Secretary may be communicated to a General Meeting on their behalf.

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